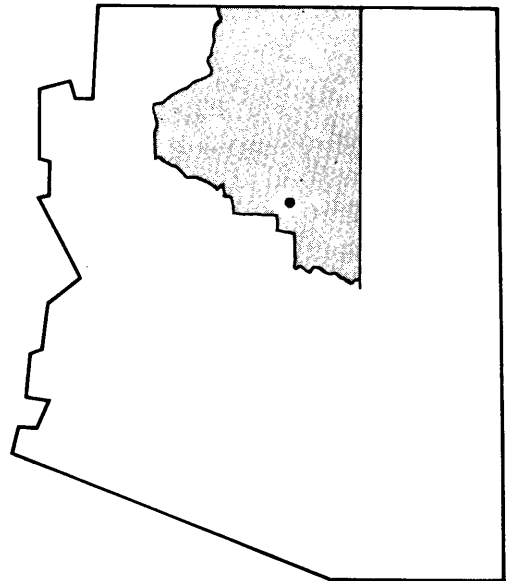


FLOOD INSURANCE STUDY



**CITY OF
WILLIAMS,
ARIZONA
COCONINO COUNTY**



JUNE 15, 1983



Federal Emergency Management Agency

COMMUNITY NUMBER-040027

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Williams, Coconino County, Arizona, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Williams to the regular program of flood insurance by the Federal Emergency Management Agency. Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by PRC Toups Corporation, for the Federal Emergency Management Agency, under Contract No. H-4700. This work, which was completed in March 1981, covered all significant flooding sources affecting Williams.

1.3 Coordination

Study areas were identified at a meeting attended by representatives of the study contractor, the Federal Emergency Management Agency, and the City of Williams on April 4, 1978.

Correspondence from the U.S. Soil Conservation Service, the Bureau of Reclamation, Arizona State University, the U.S. Army Corps of Engineers, and the Arizona Water Commission indicate that these agencies have prepared no previous flood studies or have other data pertinent to this Flood Insurance Study. The Arizona Department of Transportation and the City of Williams provided some information on flooding history.

The results of the study were reviewed at the final meeting held on August 12, 1980, and attended by representatives of the Federal Emergency Management Agency, the City of Williams, and the study contractor. The study was acceptable to the community.

Through coordination between the Federal Emergency Management Agency and the scope of study contractor, the scope of study was revised on February 26, 1982, to include analysis of Santa Fe Wash East and Santa Fe Wash West through Interstate Highway 40.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Williams, Coconino County, Arizona. The area of study is shown on the Vicinity Map (Figure 1).

Cataract Creek, Cataract Creek Tributary, Santa Fe Wash East, Santa Fe Wash West, and Cemetery Wash were studied by detailed methods within the corporate limits.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1986.

West Cataract Creek and Cataract Creek downstream of its confluence with West Cataract Creek were studied by approximate methods within the corporate limits.

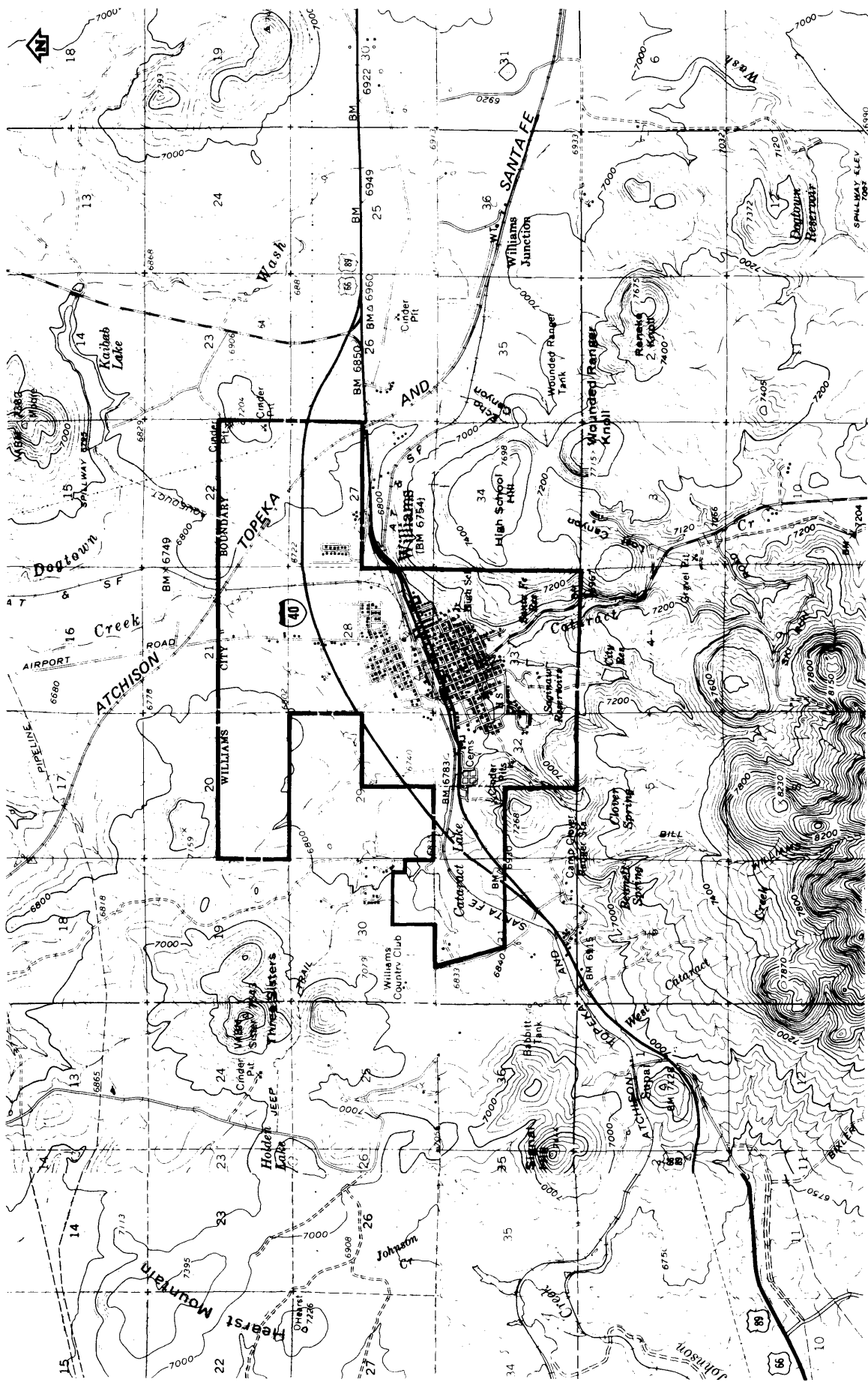
Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Emergency Management Agency and the City of Williams.

2.2 Community Description

Williams is located in southwest Coconino County, in north-central Arizona, approximately 150 miles north of Phoenix. The city is enclosed by Kaibab National Forest and is approximately 60 miles south of Grand Canyon National Park. Tourists visiting these natural attractions provide an important source of income to area residents. The 1980 population was 2,266.

The mean annual precipitation in Williams is 23 inches.

Cataract Creek, the major wash running through Williams, originates in the mountains to the south. Several small reservoirs in Williams are fed by Cataract Creek and Cataract Creek Tributary. Cataract Creek flows through a lightly populated residential area, then



FEDERAL EMERGENCY MANAGEMENT AGENCY

APPROXIMATE SCALE



CITY OF WILLIAMS, AZ
(COCONINO CO.)

VICINITY MAP

FIGURE 1

through a commercial area and again, through a lightly populated residential area as it flows through Williams.

Cemetery Wash, Santa Fe Wash West, and Santa Fe Wash East, other tributaries to Cataract Creek, also originate in the mountains south of Williams, and flow through more sparsely populated areas than does Cataract Creek.

2.3 Principal Flood Problems

The history of flooding in the Williams area indicates that constrictive hydraulic structures are a major contributing factor to flooding. Floodflows, backed up by constrictive hydraulic structures at road crossings, spread into the flood plain areas and in some instances flow overland into other washes. The overland floodflows are generally shallow, causing low-lying structures to be inundated by flows less than one foot deep.

The flood of December 1978 was caused by rainfall on the snow-covered mountains above Williams. Floodflows on Cataract Creek backed up at 5th Street, causing weir flow over 5th Street. This flow went overland, crossing at 2nd Street and the Atchison, Topeka & Santa Fe Railway. Flow also broke out on Cataract Creek at Edison Avenue, causing shallow flooding east to 2nd Street. This flood was estimated to have been approximately a 75-year flood.

2.4 Flood Protection Measures

Several reservoirs exist in Williams. Santa Fe Reservoir and City Park Reservoir are stable and will remain so in the future. Upper Saginaw Reservoir may or may not remain due to questions pertaining to the safety of the reservoir dam. All three reservoirs were considered in this Flood Insurance Study. Due to the small size and storage capabilities of the dams, the flood protection provided by these dams is limited.

Flood plain management measures used in the past to reduce potential flood damages consisted of breaching street crossings on upper Cataract Creek to increase the capacity of the wash.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance,

respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The hydrologic analysis of the watersheds affecting Williams was performed using the U.S. Soil Conservation Service TR-20 computer program (Reference 1). Results were compared with data taken from a U.S. Geological Survey gaging station with 14 years of record on a tributary to Cataract Creek within the Williams Watershed.

Discharges decrease with increasing drainage area on Cataract Creek and Cataract Creek Tributary due to storage upstream. Discharges on Cemetery Wash and portions of Cataract Creek decrease due to overbank losses upstream.

Peak discharge-drainage area relationships for the streams studied in detail are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Water-surface elevations for floods of the selected recurrence intervals were computed through the use of the U.S. Army Corps of Engineers HEC-2 step backwater computer program (Reference 2).

Cross sections used for the backwater analysis of the areas studied in detail were determined from aerial photography flown in November 1978 (Reference 3). Structural geometry and elevation data for all bridges, dams, and culverts was obtained from field observations except for structures on Interstate Highway 40. Information on structures on the interstate were obtained from Arizona Department of Transportation design plans (Reference 4).

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second)		
		10-Year	50-Year	500-Year
Cataract Creek				
Upstream of Santa Fe Reservoir Dam	4.95	173	601	2,500
Downstream of Santa Fe Reservoir Dam	4.95	110 ¹	411 ¹	2,200 ¹
Downstream of Confluence With Cataract Creek Tributary	6.61	136	486	2,400
At U.S. Highways 66 & 89	7.15	153	524	2,400
At Confluence With West Cataract Creek	7.15	153	519 ²	2,400
Cataract Creek Tributary				
Above City Park Dam	1.4	64 ¹	257 ¹	1,100 ¹
Below City Park Dam	1.4	28 ¹	91 ¹	360 ¹
Santa Fe Wash East				
At U.S. Highways 66 & 89	0.92	81	250	900
Upstream of Confluence With Santa Fe Wash West	4.91	156	481	1,750
At Confluence With Cataract Creek	5.82	304	792	2,500
Santa Fe Wash West				
At U.S. Highways 66 & 89	0.56	182	393	1,340
At Confluence With Santa Fe Wash East	0.91	184	419	1,340
Cemetery Wash				
At U.S. Highways 66 & 89	1.06	50	209	1,050
At Confluence With West Cataract Creek	1.06	47 ²	185 ²	259 ²

¹Decrease Due to Storage Upstream²Decrease Due to Overbank Losses Upstream³Discharge Not Computed

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Hydraulic roughness coefficient (Manning's "n") values used in the hydraulic computations, were chosen by engineering judgment and based on field observations of the study areas, and range from 0.013 to 0.055 for the channels and from 0.014 to 0.080 for overbank areas.

Starting water-surface elevations for Cataract Creek and Cataract Creek Tributary were derived from normal-depth calculations. Starting water-surface elevations for Santa Fe Wash East were determined using critical depth. Starting water-surface elevations for Santa Fe Wash West were taken from Santa Fe Wash East. Starting water-surface elevations for Cemetery Wash were derived from a rating curve for the culverts at Interstate Highway 40.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Areas of shallow flooding were determined by the U.S. Army Corps of Engineers HEC-2 computer program (Reference 2) and by engineering judgment.

Flood elevations for areas studied by approximate methods were determined from normal-depth calculations.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Reference 5).

Approximate flood boundaries in some portions of the study area were taken from topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Reference 5), and from the Flood Hazard Boundary Map for Coconino County (Reference 6).

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the Federal Emergency Management Agency limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain.

The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

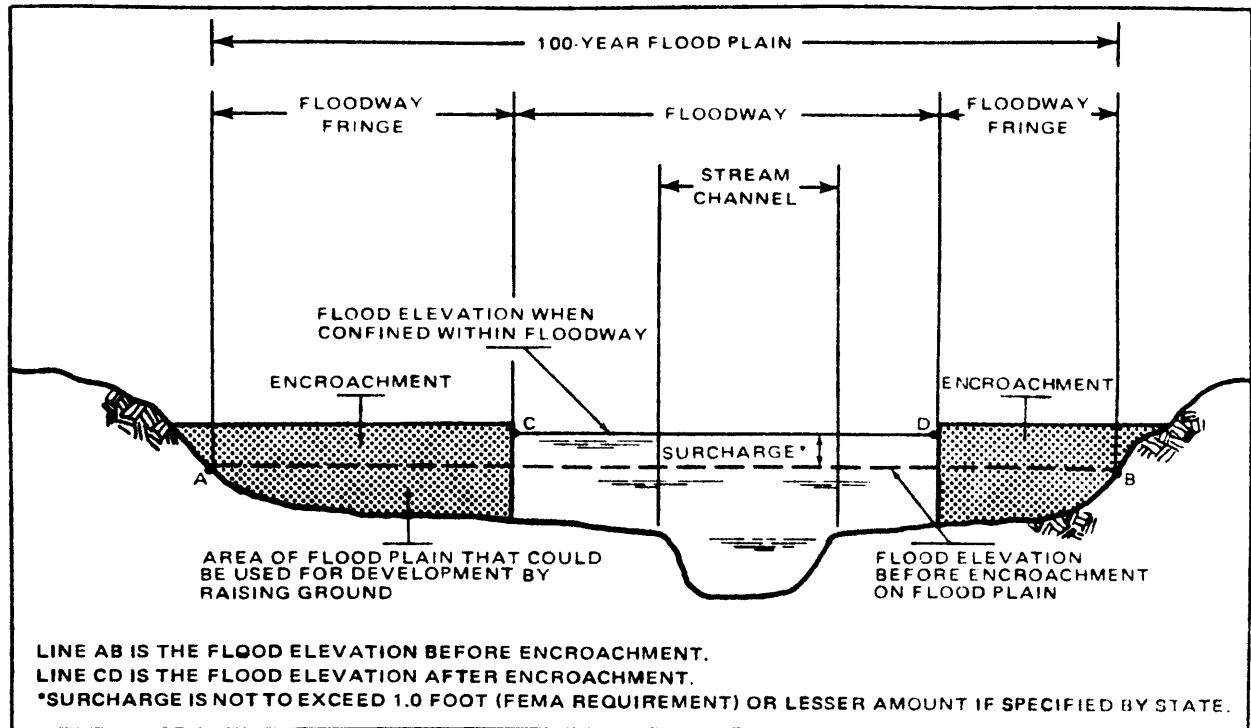


Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
(FEET NGVD)								
Cataract Creek								
A	0.120	46/30 ²	160	4.8	6,729.8	6,729.8	6,730.6	0.8
B	0.175	44/10 ²	234	3.3	6,730.4	6,730.4	6,731.3	0.9
C	0.255	44	155	4.9	6,731.0	6,731.0	6,731.5	0.5
D	0.280	29	66	8.6	6,733.1	6,733.1	6,733.1	0.0
E	0.370	35	97	5.9	6,739.4	6,739.4	6,739.5	0.1
F	0.490	33	89	6.4	6,744.9	6,744.9	6,745.0	0.1
G	0.510	100	279	2.5	6,747.3	6,747.3	6,748.0	0.7
H	0.560	80	151	4.5	6,748.2	6,748.2	6,748.5	0.3
I	0.660	31	101	6.8	6,752.5	6,752.5	6,753.2	0.7
J	0.690	80	251	3.3	6,756.5	6,756.5	6,756.9	0.4
K	0.790	44	97	8.5	6,761.3	6,761.3	6,761.3	0.0
L	0.830	57	106	7.8	6,765.3	6,765.3	6,765.3	0.0
M	0.870	35	107	7.7	6,767.9	6,767.9	6,768.0	0.1
N	0.890	49	167	4.9	6,769.4	6,769.4	6,769.5	0.1
O	0.910	51	198	4.2	6,770.0	6,770.0	6,770.1	0.1
P	0.930	38	169	5.0	6,771.3	6,771.3	6,771.3	0.0
Q	0.970	47	157	5.4	6,771.8	6,771.8	6,772.2	0.4
R	0.990	75	292	3.1	6,774.3	6,774.3	6,775.3	1.0
S	1.040	46	105	8.6	6,776.6	6,776.6	6,776.6	0.0
T	1.060	73	361	2.5	6,780.7	6,780.7	6,781.7	1.0
U	1.110	52	112	8.1	6,781.7	6,781.7	6,781.8	0.1
V	1.130	91	389	2.3	6,784.6	6,784.6	6,785.6	1.0
W	1.180	40	108	8.3	6,789.0	6,789.0	6,789.2	0.2
X	1.200	95	369	2.7	6,792.9	6,792.9	6,793.8	0.9
Y	1.250	70	315	3.5	6,797.9	6,797.9	6,798.3	0.4
Z	1.320	25	99	11.2	6,802.1	6,802.1	6,802.4	0.3

¹Miles Above Confluence With West Cataract Creek ²Width/Width Within Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

CATARACT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Cataract Creek (Cont'd)								
AA	1.390	40	135	8.2	6,812.0	6,812.0	6,813.0	1.0
AB	1.470	57	115	8.2	6,821.3	6,821.3	6,821.3	0.0
AC	1.500	413	2,213	0.5	6,873.5	6,873.5	6,873.5	0.0
AD	1.650	320	1,603	0.7	6,873.5	6,873.5	6,873.5	0.0
AE	1.810	255	1,266	0.9	6,873.5	6,873.5	6,873.5	0.0
AF	1.940	116	419	2.6	6,873.5	6,873.5	6,873.5	0.0
AG	2.010	65	153	7.2	6,879.6	6,879.6	6,879.6	0.0

¹Miles Above Confluence With West Cataract Creek

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

CATARACT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Cataract Creek Tributary								
A	1.44	55	38	4.8	6,820.4	6,820.4	6,820.4	0.0
B	1.54	27	30	6.1	6,839.7	6,839.7	6,839.7	0.0
C	1.70	195	3,875	0.1	6,895.1	6,895.1	6,895.1	0.0
D	1.78	190	2,196	0.1	6,895.1	6,895.1	6,895.1	0.0
E	1.87	103	495	0.4	6,895.1	6,895.1	6,895.1	0.0
F	1.91	41	78	2.4	6,895.1	6,895.1	6,895.1	0.0

¹Miles Above Confluence With West Cataract Creek

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

CATARACT CREEK TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Santa Fe Wash East								
A	0.060	54	168	8.5	6,715.8	6,715.8	6,716.0	0.2
B	0.130	100	424	3.3	6,718.4	6,718.4	6,718.4	0.0
C	0.170	150	466	1.8	6,718.8	6,718.8	6,718.8	0.0
D	0.280	141	299	2.8	6,719.0	6,719.0	6,719.2	0.2
E	0.390	166	346	2.4	6,719.7	6,719.7	6,719.7	0.0
F	0.480	63	121	6.9	6,720.3	6,720.3	6,720.3	0.0
G	0.600	69	225	3.7	6,722.4	6,722.4	6,722.4	0.0
H	0.670	150	148	5.7	6,725.0	6,725.0	6,725.0	0.0
I	0.800	455	469	1.8	6,727.1	6,727.1	6,727.1	0.0
J	0.950	285	183	4.2	6,729.7	6,729.7	6,730.2	0.5
K	1.125	183	282	2.5	6,735.2	6,735.2	6,736.1	0.9
L	1.270	50/10 ²	127	6.0	6,740.4	6,740.4	6,740.7	0.3
M	1.360	97	271	2.8	6,742.3	6,742.3	6,742.3	0.0
N	1.460	50	99	7.8	6,744.2	6,744.2	6,744.5	0.3
O	1.480	80	356	2.2	6,749.3	6,749.3	6,749.7	0.4
P	1.640	32	84	9.2	6,753.2	6,753.2	6,753.6	0.4
Q	1.840	66	133	5.8	6,765.1	6,765.1	6,765.6	0.5

¹Miles Above Confluence With Cataract Creek ²Width/Width Within Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

SANTA FE WASH EAST

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Santa Fe Wash West								
A	0.030	84	197	3.6	6,718.5	6,718.5	6,718.5	0.0
B	0.130	232	371	1.9	6,719.6	6,719.6	6,719.6	0.0
C	0.210	170	167	4.2	6,720.8	6,720.8	6,720.8	0.0
D	0.260	65	131	5.4	6,721.8	6,721.8	6,721.9	0.1
E	0.340	62	148	4.8	6,723.2	6,723.2	6,723.2	0.0
F	0.410	78	281	2.5	6,724.1	6,724.1	6,724.2	0.1
G	0.540	274	328	2.2	6,727.3	6,727.3	6,727.3	0.0
H	0.680	134	132	5.3	6,730.3	6,730.3	6,730.3	0.0
I	0.770	214	278	2.6	6,732.7	6,732.7	6,732.7	0.0
J	0.830	500	1,580	0.4	6,737.2	6,737.2	6,737.3	0.1
K	1.010	240	163	3.9	6,738.9	6,738.9	6,738.9	0.0
L	1.120	295	229	2.8	6,744.3	6,744.3	6,744.3	0.0
M	1.179	123	125	5.1	6,747.1	6,747.1	6,747.1	0.0
N	1.220	30	146	4.1	6,753.8	6,753.8	6,753.8	0.0
O	1.340	55	236	1.4	6,754.3	6,754.3	6,754.9	0.6
P	1.480	20	28	6.8	6,759.3	6,759.3	6,760.2	0.9
Q	1.560	51	91	2.1	6,762.1	6,762.1	6,763.1	1.0

¹Miles Above Confluence With Santa Fe Wash East

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

SANTA FE WASH WEST

FLOODING SOURCE		FLOODWAY		BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY INCREASE
Cemetery Wash							
A	0.14	1,005	1,581	0.2	6,741.0	6,741.0	0.0
B	0.21	25	48	8.0	6,741.9	6,741.9	0.4
C	0.40	111	97	4.0	6,755.5	6,755.5	0.7
D	0.42	34	53	7.2	6,759.1	6,759.1	0.9
E	0.51	31	65	5.9	6,764.6	6,764.6	0.2
F	0.58	25	48	8.0	6,768.9	6,768.9	0.4
G	0.62	60	202	1.9	6,773.1	6,773.1	0.0
H	0.64	108	341	1.1	6,778.5	6,778.5	0.0
I	0.72	65	69	5.6	6,781.3	6,781.3	0.0
J	0.74	25	52	7.4	6,783.2	6,783.2	0.0
K	0.83	38	61	6.3	6,790.5	6,790.5	0.0
L	0.86	38	61	6.3	6,794.2	6,794.2	0.0
M	0.93	43	64	6.0	6,802.0	6,802.0	0.0

¹Miles Above Confluence With West Cataract Creek

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOODWAY DATA

CEMETARY WASH

the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF's), and flood insurance zone designations for each flooding source studied in detail affecting Williams.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

<u>Average Difference Between 10- and 100-Year Floods</u>	<u>Variation</u>
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Williams are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The FHF is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHF's from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHF's, the entire incorporated area of Williams was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

FLOODING SOURCE	PANEL ¹	ELEVATION DIFFERENCE ² BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION ³ (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Cataract Creek Reach 1 Sheetflow	0002,0004 0002	-2.1 N/A	-0.8 N/A	0.9 N/A	020 N/A	A4 A0	Varies - See Map Depth 1
Cataract Creek Tributary Reach 1 Reach 2	0004 0004	-2.1 -1.0	-0.8 -0.5	0.9 0.7	020 010	A4 A2	Varies - See Map Varies - See Map
Santa Fe Wash East Reach 1 Reach 2 Reach 3	0002 0002 0002	-2.0 -1.2 -1.3	-1.0 -0.5 -0.5	2.2 1.2 1.0	020 010 015	A4 A2 A3	Varies - See Map Varies - See Map Varies - See Map
Santa Fe Wash West Reach 1 Reach 2 Reach 3 Reach 4 Reach 5 Reach 6 Reach 7 Sheetflow Ponding	0002 0002 0002 0002 0002 0002 0002 0002 0002	-2.1 -1.3 -1.1 -2.0 -0.8 -2.7 -0.8 N/A N/A	-0.9 -0.5 -0.6 -0.1 -0.3 -1.5 -0.5 N/A N/A	1.9 0.7 0.6 0.3 0.7 4.1 1.2 N/A N/A	020 015 010 020 010 025 010 N/A N/A	A4 A3 A2 A4 A2 A5 A2 A0 AH	Varies - See Map Varies - See Map Varies - See Map Varies - See Map Varies - See Map Varies - See Map Varies - See Map Depth 1 6737
Cemetery Wash Reach 1 Reach 2	0002 0002,0004	-1.4 -1.9	-0.5 -0.8	0.2 1.5	015 020	A3 A4	Varies - See Map Varies - See Map

¹Flood Insurance Rate Map Panel ²Weighted Average ³Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

FLOOD INSURANCE ZONE DATA

CATARACT CREEK-CATARACT CREEK TRIBUTARY-SANTA FE WASH EAST
SANTA FE WASH WEST-CEMETARY WASH

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHF's determined.
Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHF's are determined.
Zone AH:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHF's are determined.
Zones A2-A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF's.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, FHF's, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Williams is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance

map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

A Flood Insurance Study is being prepared for the unincorporated areas of Coconino County (Reference 7), and is in agreement with this study.

This Flood Insurance Study supercedes the Flood Hazard Boundary Map for Williams (Reference 8).

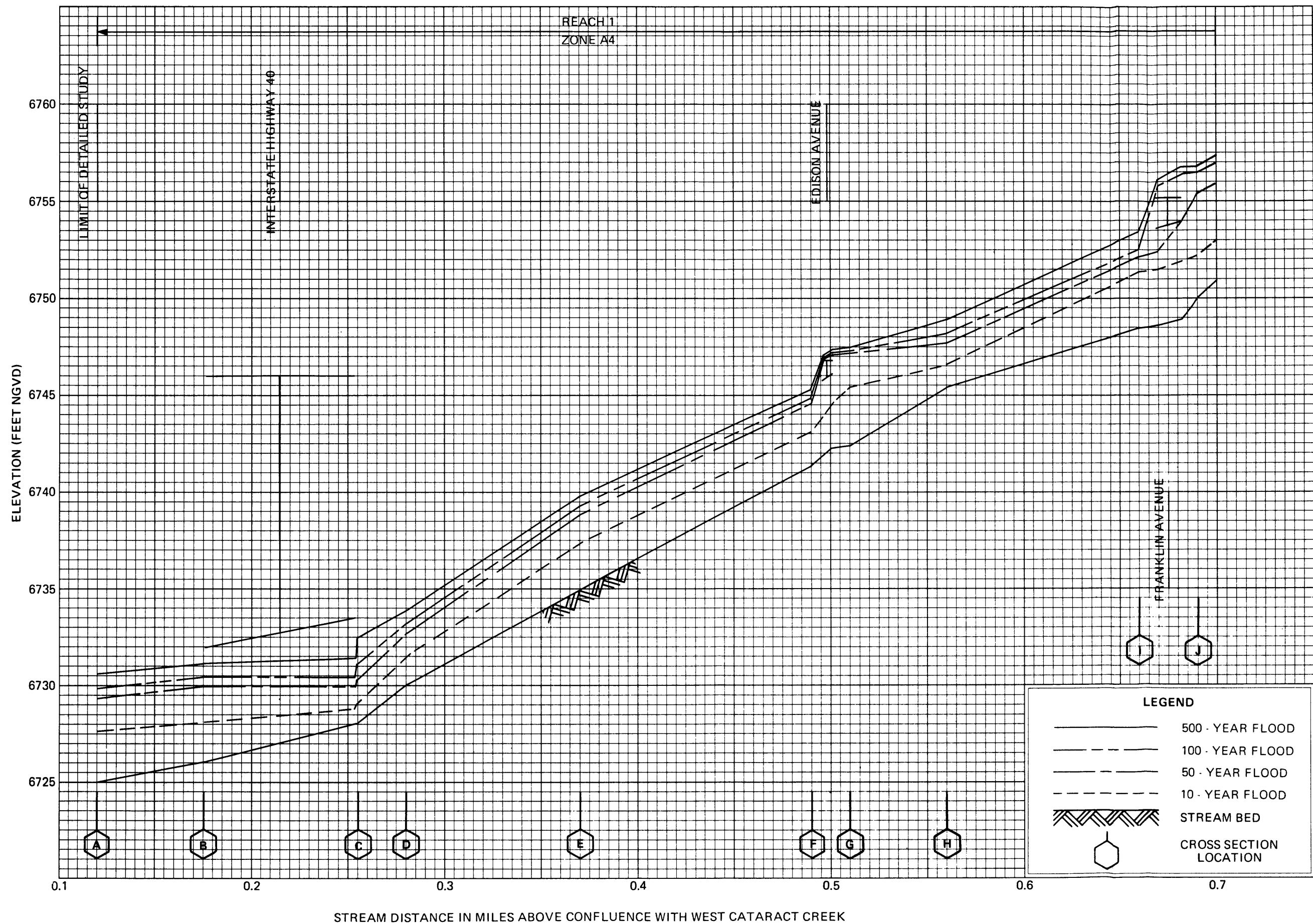
This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Building 105, Presidio of San Francisco, San Francisco, California 94129.

8.0 BIBLIOGRAPHY AND REFERENCES

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2. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, November 1976
3. Aerial Mapping Company, Aerial Photographs, Coconino County, Arizona, Scale 1:14,400, November 1978
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5. PRC Toups Corporation, Topographic Maps, Scale 1:4,800, Contour Interval 4 feet, Phoenix, Arizona, 1978
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8. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Williams, Arizona, Scale 1:12,000, revised December 12, 1975



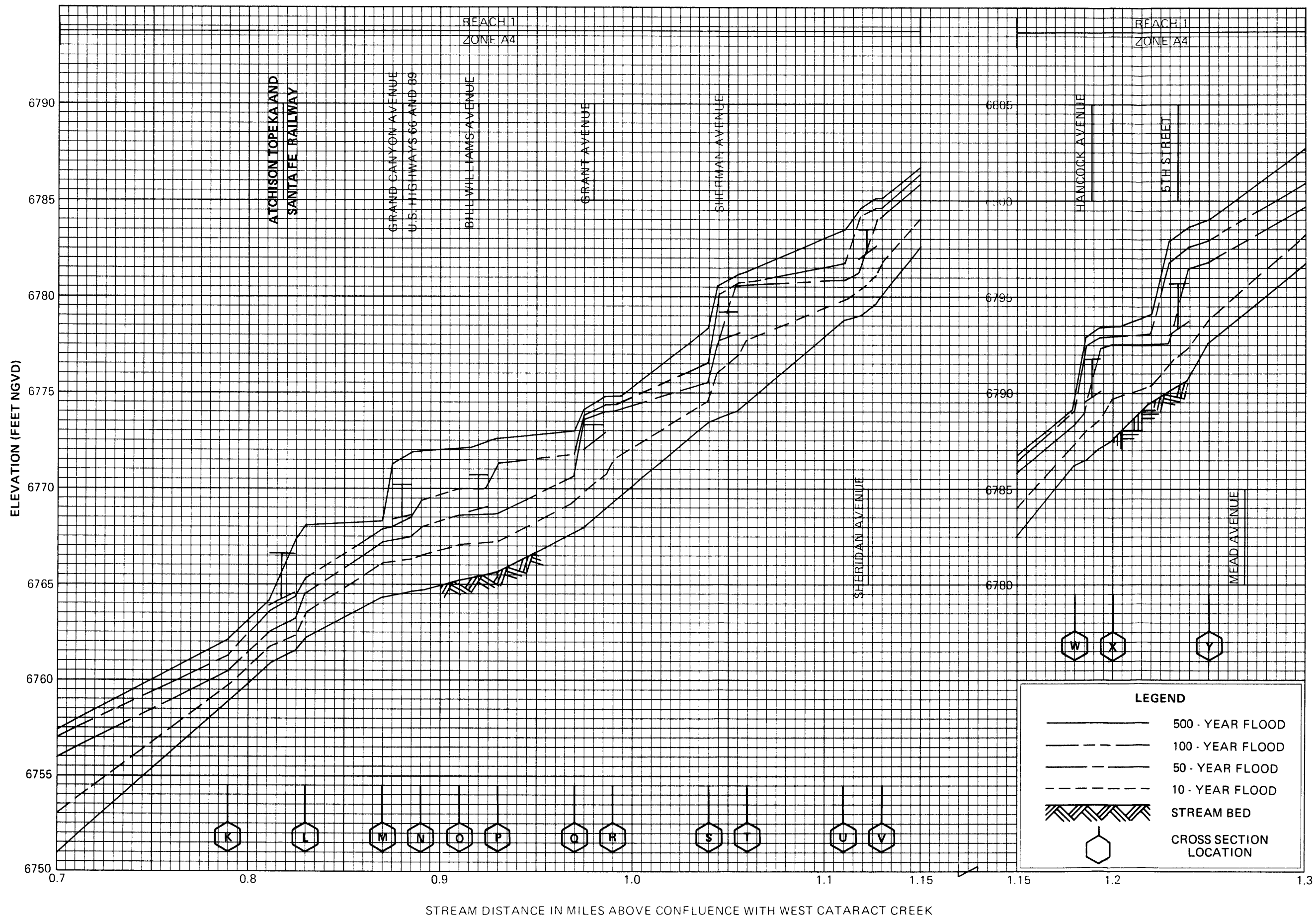
FLOOD PROFILES

CATARACT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

01P



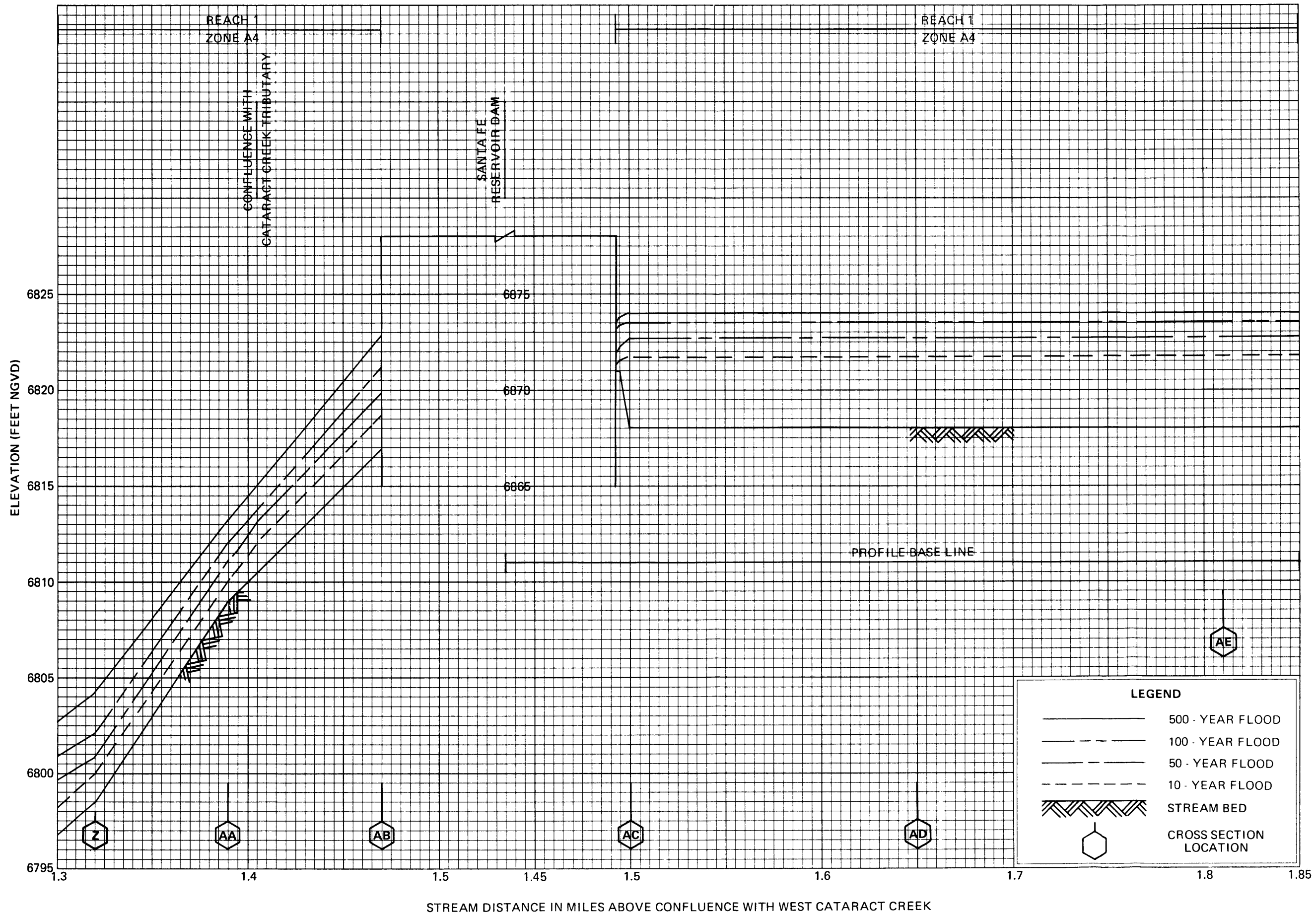
FLOOD PROFILES

CATARACT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

02P

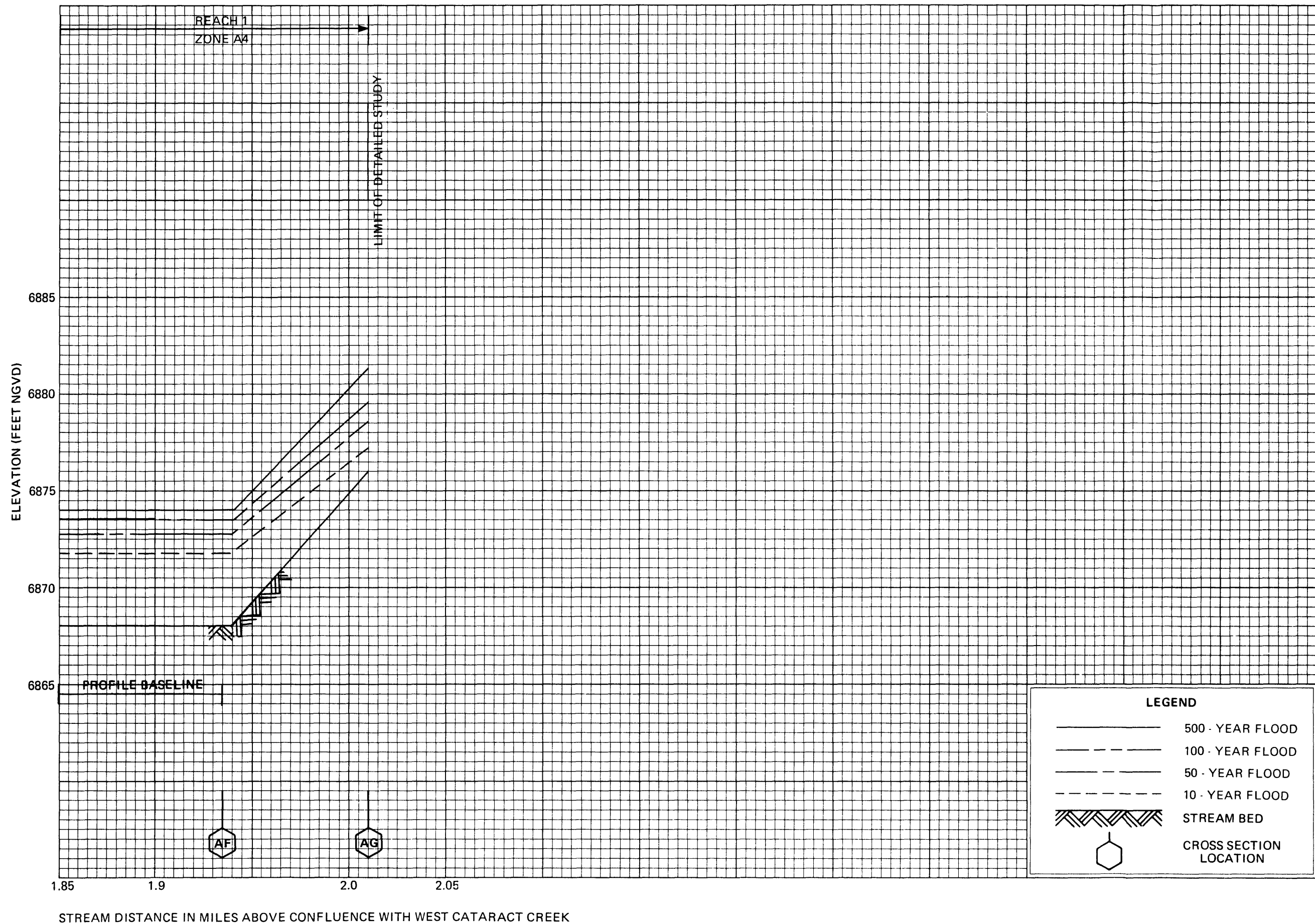


FLOOD PROFILES

CATARACT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)



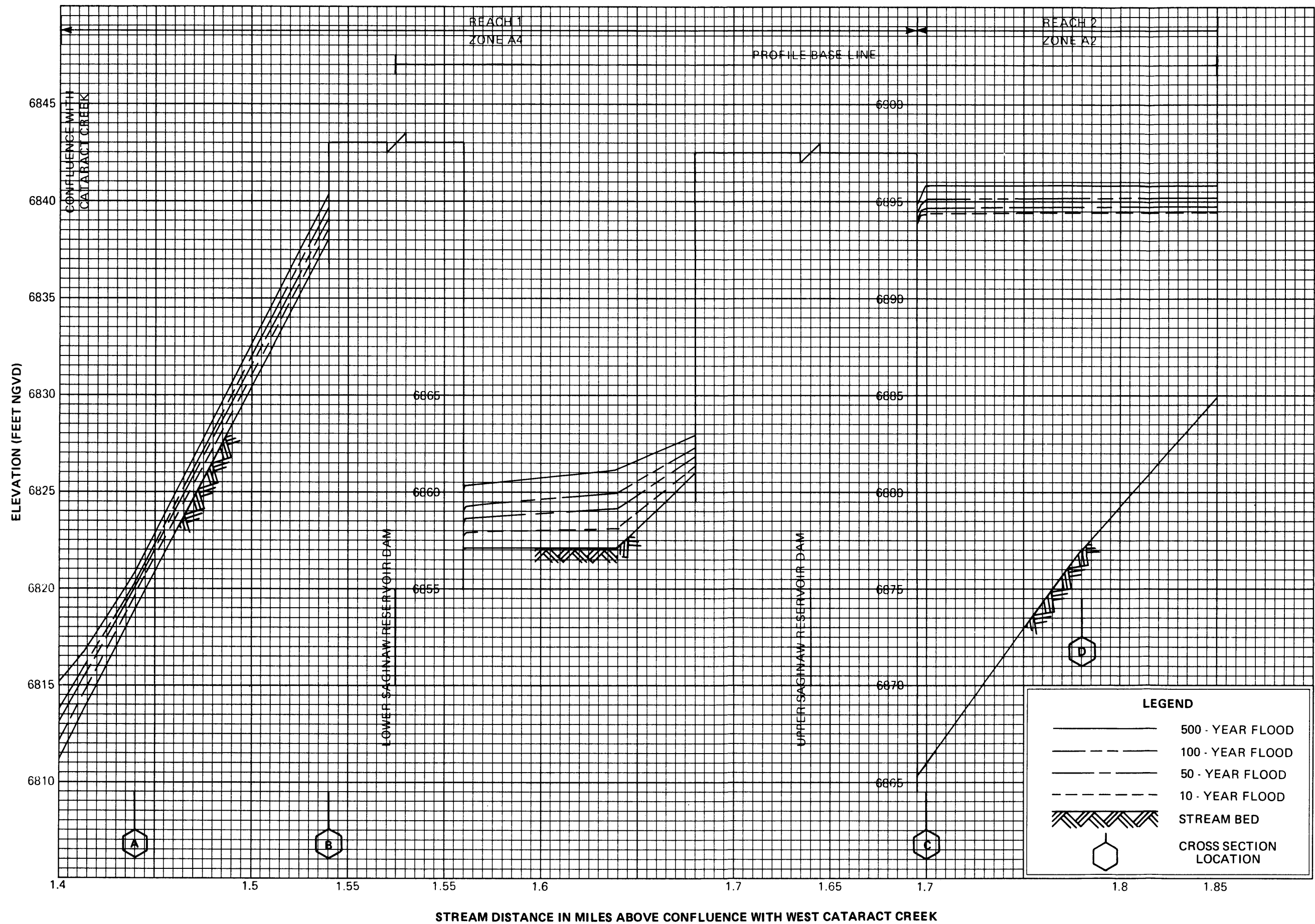
FLOOD PROFILES

CATARACT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

04P



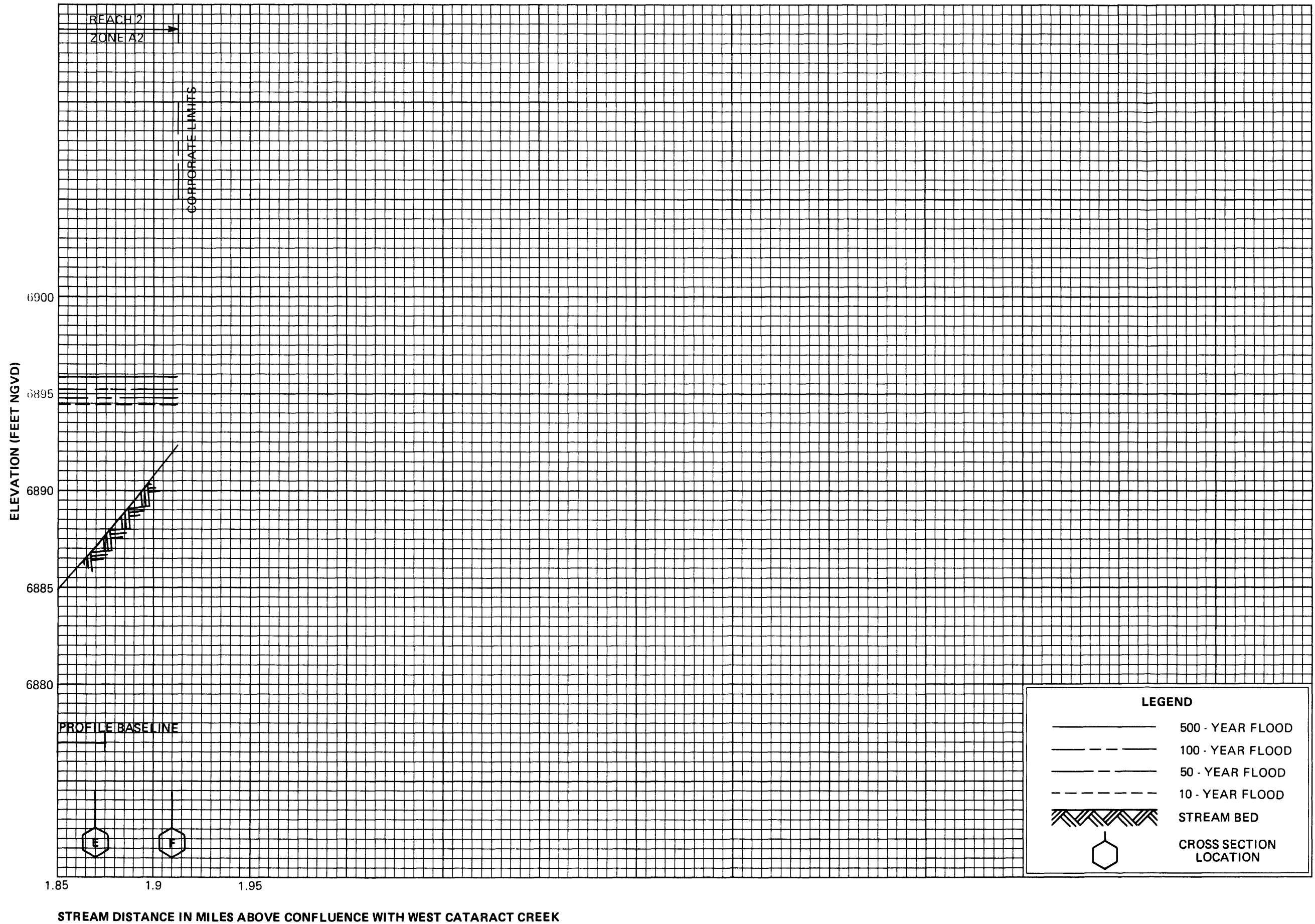
FLOOD PROFILES

CATARACT CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

05P



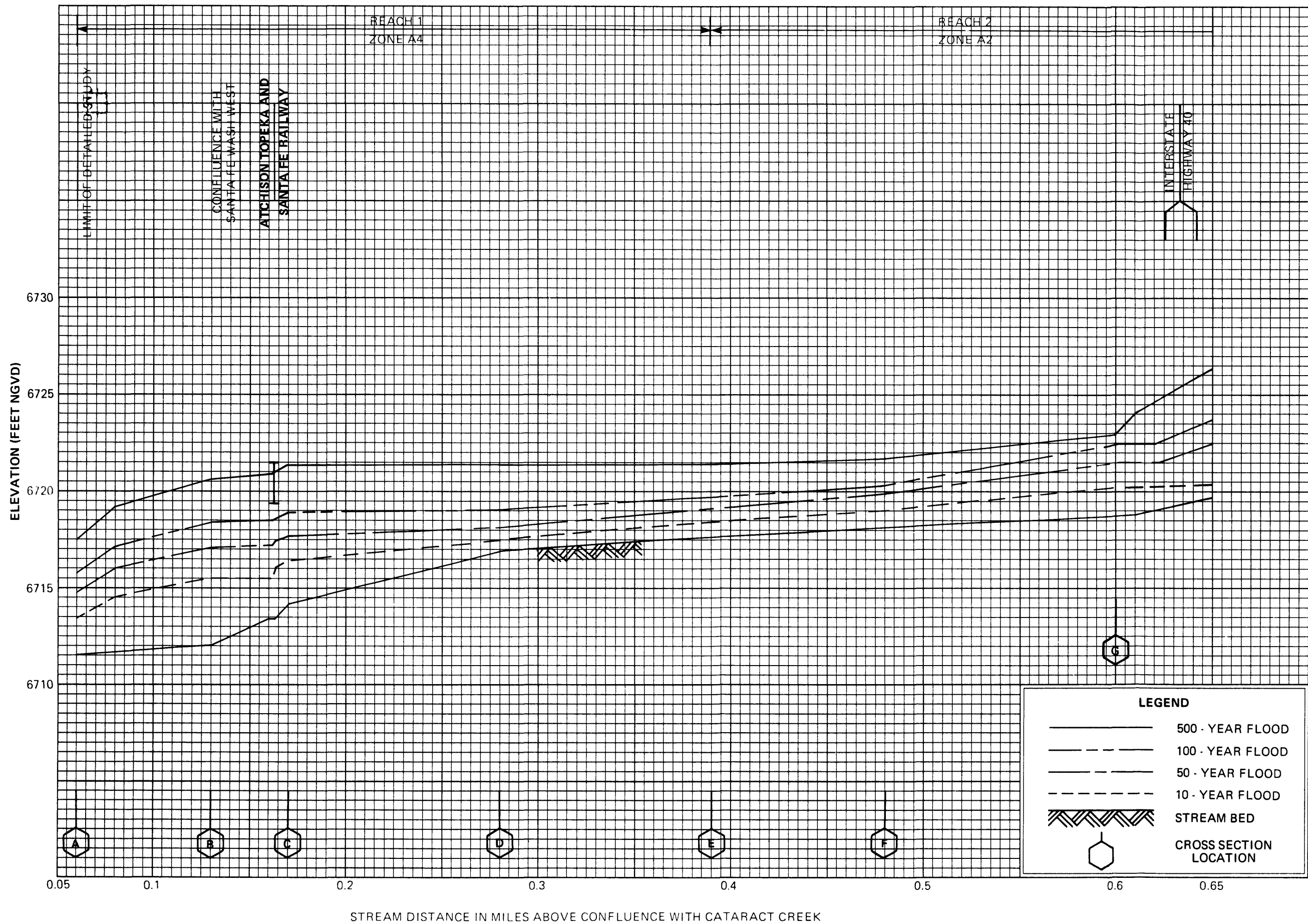
FLOOD PROFILES

CATARACT CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

06P



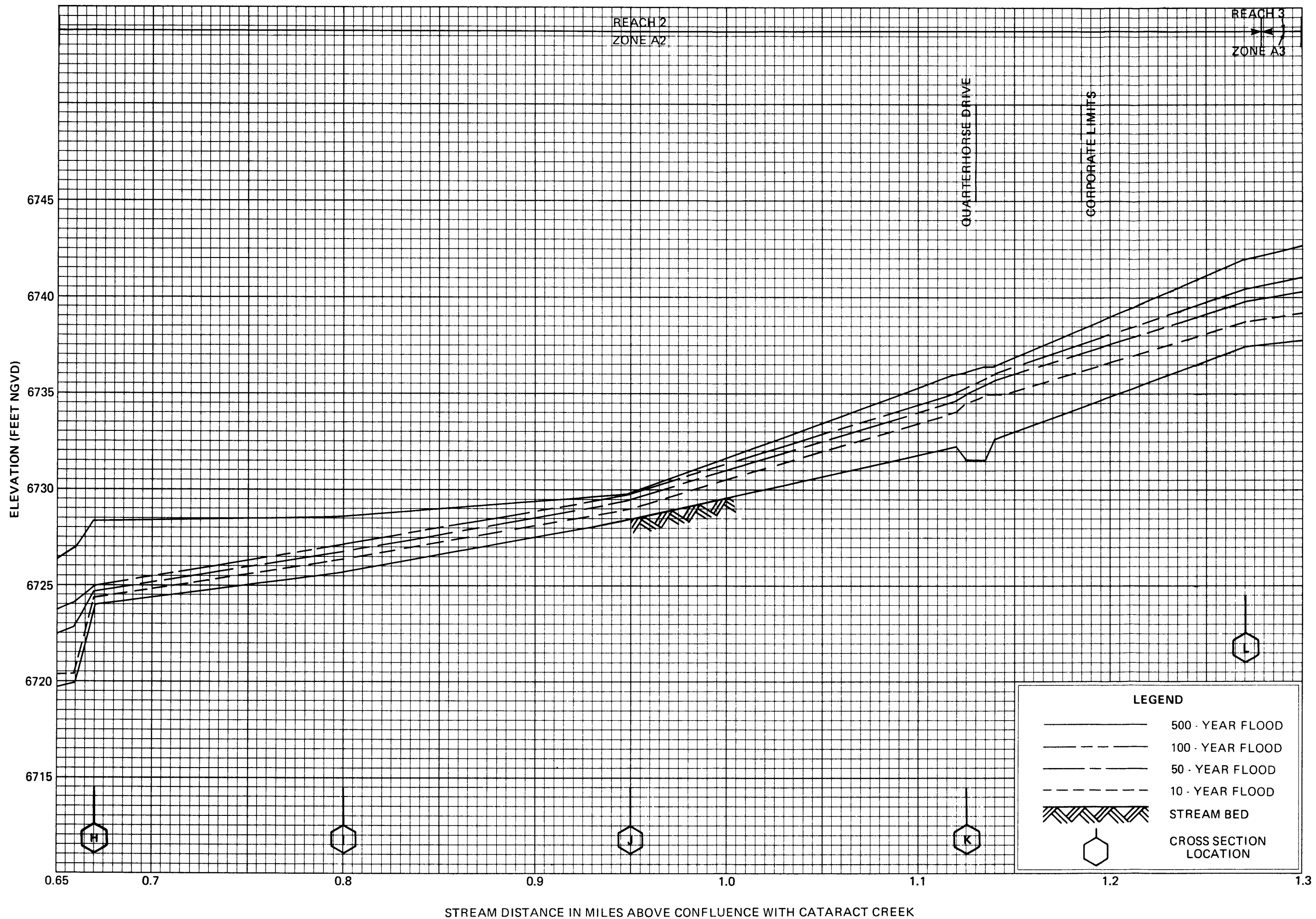
FLOOD PROFILES

SANTA FE WASH EAST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

07P

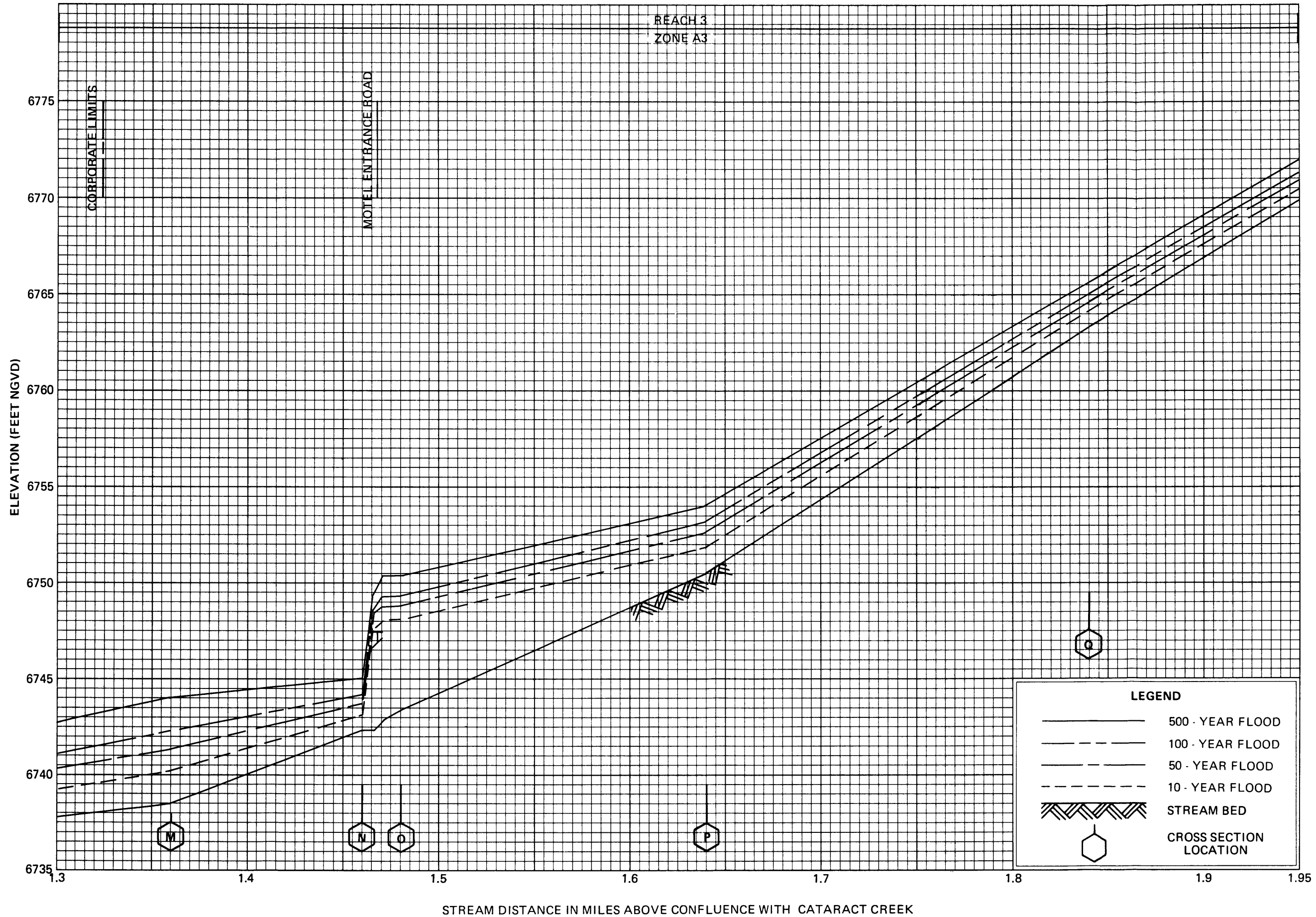


FLOOD PROFILES

SANTA FE WASH EAST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)



FLOOD PROFILES

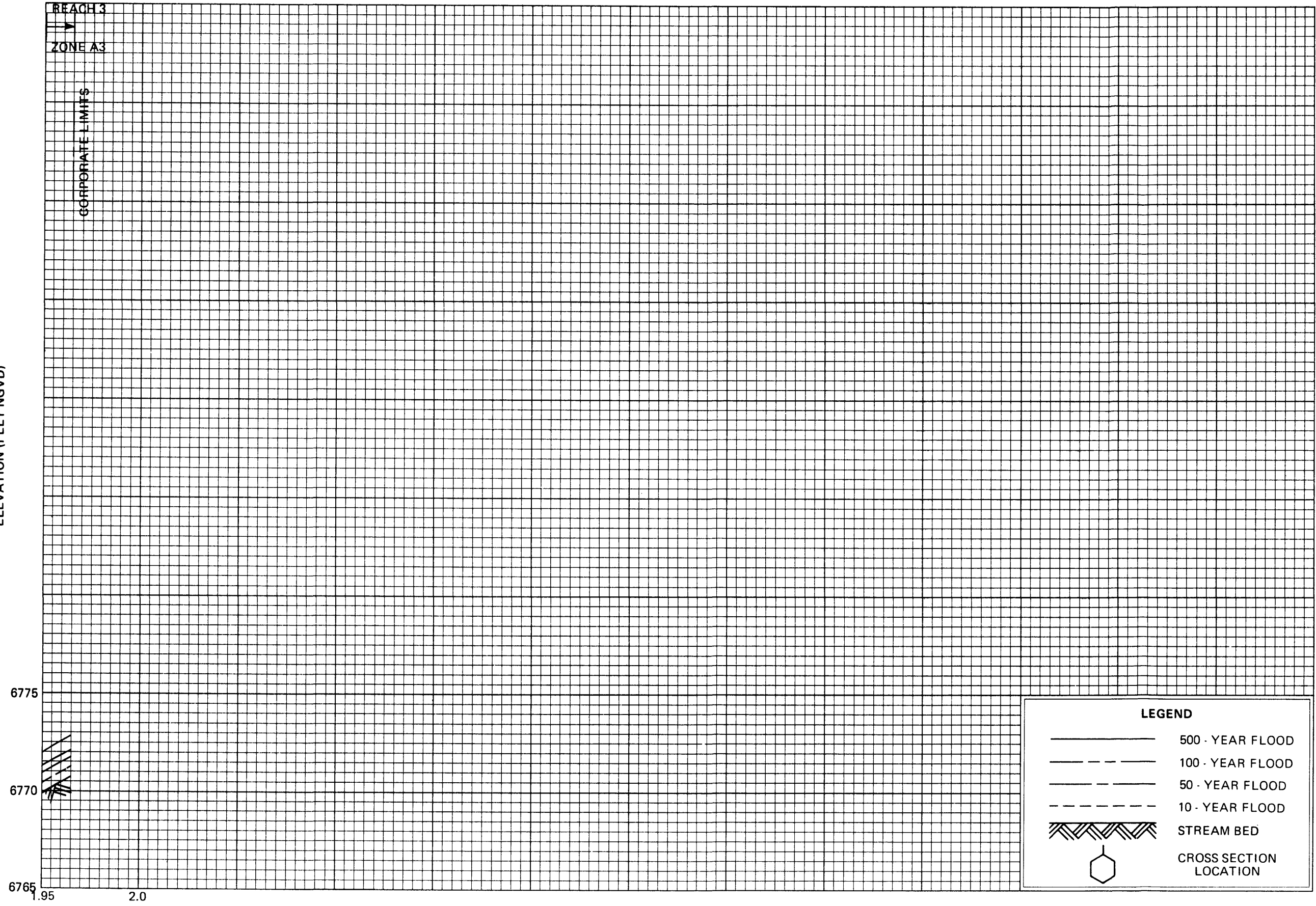
SANTA FE WASH EAST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

09P

ELEVATION (FEET NGVD)



STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CATARACT CREEK

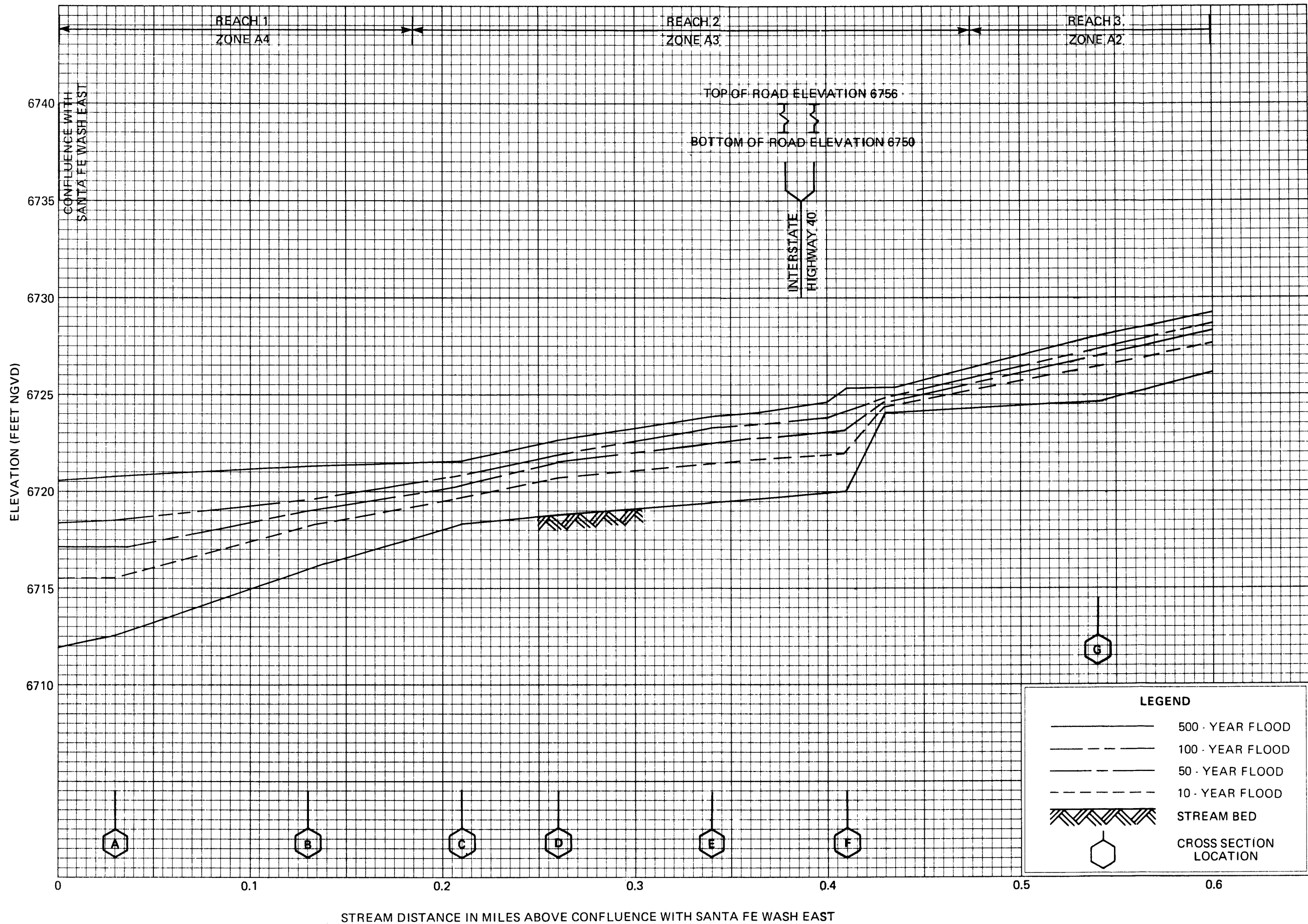
FLOOD PROFILES

SANTA FE WASH EAST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

10P

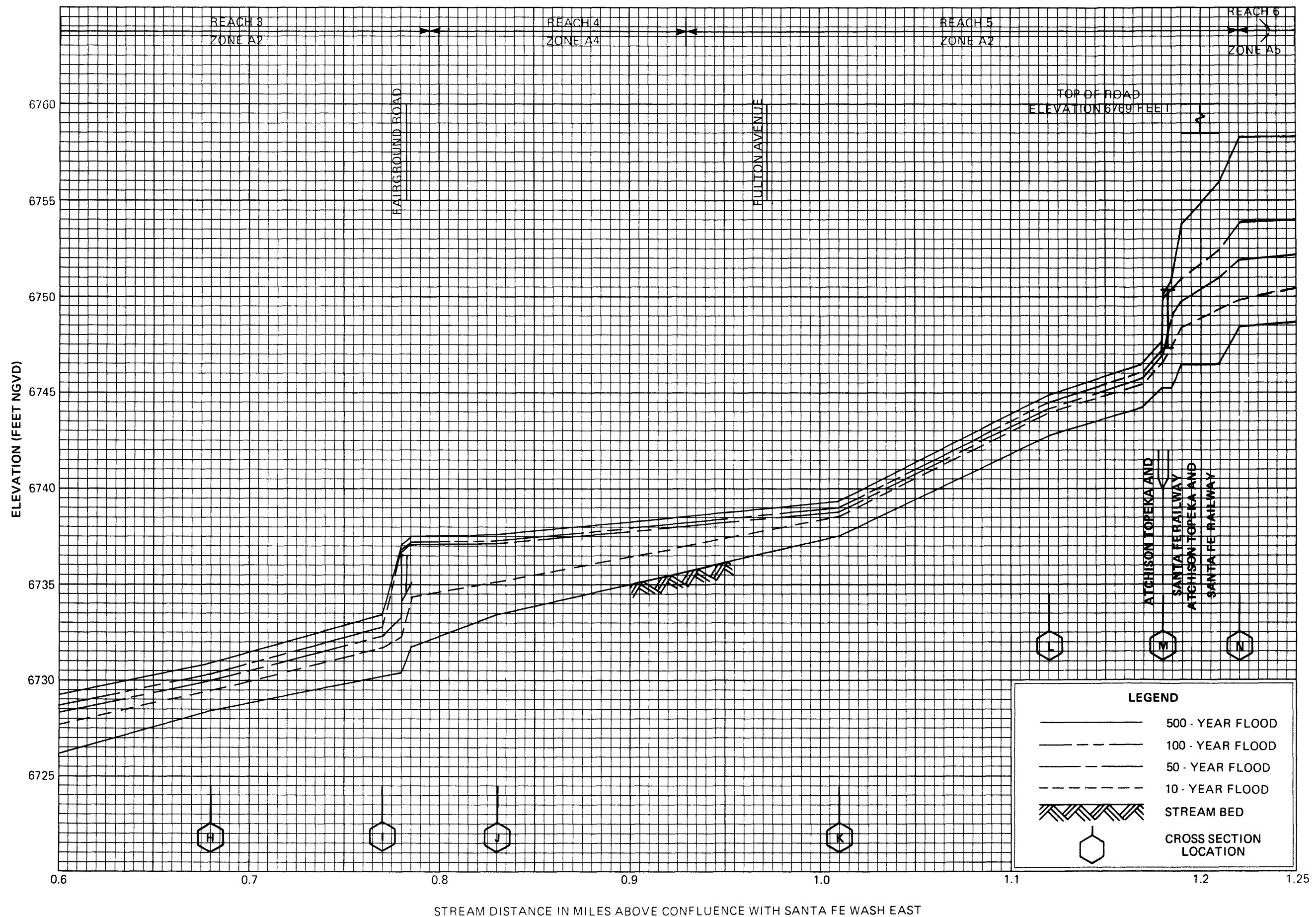


FLOOD PROFILES

SANTA FE WASH WEST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)

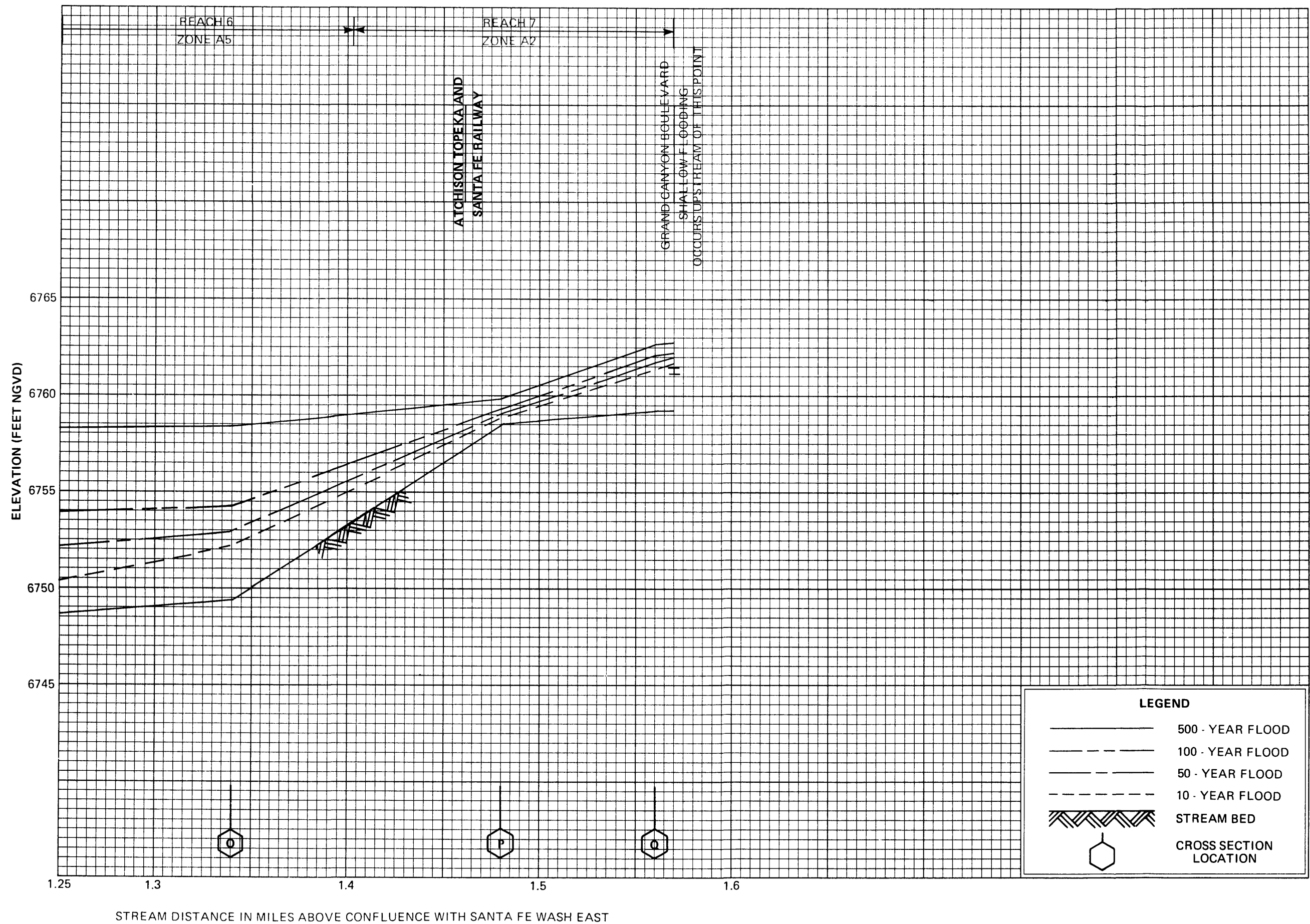


FLOOD PROFILES

SANTA FE WASH WEST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)



FLOOD PROFILES

SANTA FE WASH WEST

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
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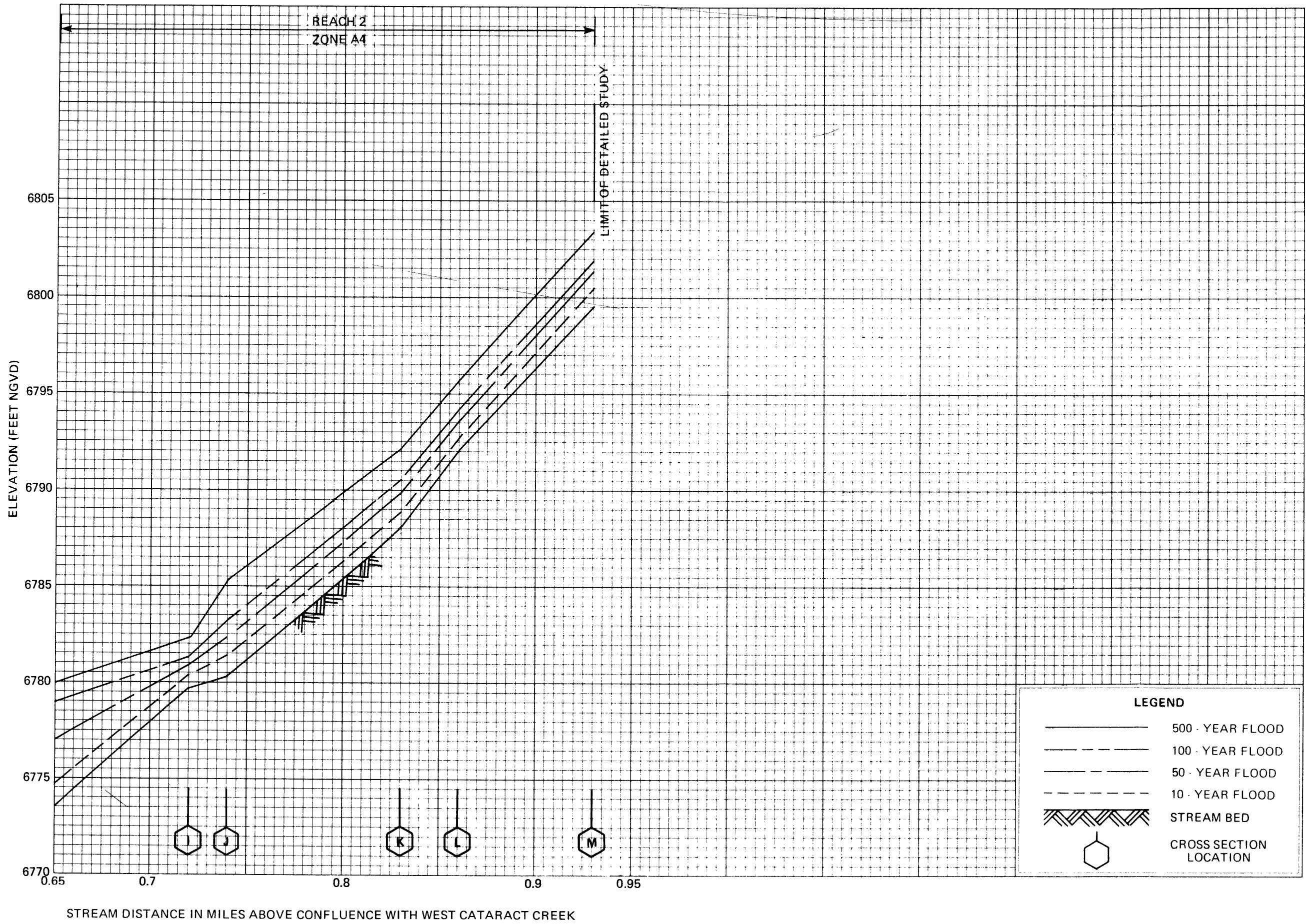


FLOOD PROFILES

CEMETARY WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WILLIAMS, AZ
(COCONINO CO.)



FLOOD PROFILES

CEMETARY WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

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